

Transformation of Wooden Pallets to Plastic Pallets

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Abstract

Pallets are a crucial component of global logistics and play a significant role in ecological impact; an estimated 5 to 7 billion trees are felled for raw materials, a large portion of which goes into the production of wooden pallets. This paper reviews the transformation of wooden pallets to plastic pallets with the intent of providing insights into the methodological choices made, as well as compiling the data from the studies reviewed. The study includes analysis of market challenges, cost comparison, reliability and quality, which will diversify the global logistics system

Keywords: Lumber, logistics, trees, ecology system

Introduction

With increasing global trade and logistics activity, products and commodities must be transported securely across the supply chain from vendors to manufacturers, and onward to distributors and retail outlets, manufacturers to stores, stores to distributors, distributors to retail outlets for consumers. As global trade expands, pallets play an increasingly vital role in supply chain operations, as they move from the initial producer to the final consumer. According to the market estimated by Globe Newswire [1], the global wooden pallets market

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to surpass from US\$2.3Bn to US\$3.8Bn valuation by 2032 with overall demand increasing at 5.4%. The Indian wood pallet industry is anticipated to expand at a compound annual growth rate of 5.6% over the coming years, generating an estimated additional market value of USD 115 million. While this presents significant economic potential, it also raises environmental concerns, particularly related to increased deforestation. Though there are many alternatives to wooden pallets, such as LVL (Laminated Veneer Lumber) pallets, Paper Pallets, Corrugated pallets, Press wood pallets, etc. Plastic pallets seem to be the best alternative.

Literature Review

Pallets play a vital role in the global distribution of raw materials due to their widespread use and proven efficiency. Therefore, it is essential to examine the different methodologies involved, offering insight into the complexity of the issue. By analysing current challenges and proposing recommendations for the ecological system, a foundation is established for selecting the most suitable strategies and features to guide future advancements in material handling and transportation.

The table below presents a comparative analysis by NAEKO, evaluating various technical and practical factors:

Area of Comparison	Wooden Pallets	Plastic Pallets
Steadiness	When exposed to moisture or water, their dimensions and weight tend to fluctuate.	It remains consistently stable under varying environmental conditions.
Cleanliness	Can form fungus/mold if not maintained in closed area	It is water-resistant and no possibility of forming infection
Life span	If used without damage, can be used for multiple times	Its stable until the end and more resilient than wood
Preservation	Based on usage, it requires preservation to avoid cause splits, protruding nails and chips in corner	Can be washed if dirt and no preservation required until damage
Handlings	Heat treatments required to avoid fungus/mold	No treatment required
Trades	For assured trades, essential to document their process (ISPM 15)	Not required

Tracking	Not possible due to its nature	Can be tracked by RFID chips, barcodes, etc.
Reuse	Cannot utilized after multiple times due to wear/tear	Can be utilized 100% and has an high outstanding value which allow the buyer to recover his investment.
Environment	It is produced by cutting the trees.	It can be produced by use of recyclable materials or plastic resins which save cutting trees.
Residual value	After its been used not have value to the buyer	Buyer can recover his investment since it can be reuse for new plastic pallets

Rising demand can serve as a key driving force across various industries, helping streamline operations in many cases. The following areas represent primary points of interest for entrepreneurs and industrial leaders alike

Focused Area	Wooden Pallets	Plastic Pallets
Costings	31 USD/Per Pc	21 USD/Per Pc
Weight	Approx. 14-17KG	Approx. 18-22 KG
Cleanliness	Exposure to moisture is not recommended, as these items are challenging to clean and may be difficult to repair	Well-suited for cleaning with water or various cleansing agents
HSE Risks	Possibility on having work accidents by splinters or protruding nails	Easy to handle.
Rejection	It can have many rejections on production lines due to pallet quality.	Due to resistance and unchanged shaped will avoid rejection at the production lines

Costing: It has a major part where the industrialist/entrepreneur though the other elements are checked, but it can directly impact to their balance sheet, which can result in profit/loss

- **Weight:** The movement of the pallets is across the Globe, and the durability, as well as the shipping costs, will depend on total weight, which is the key to deciding based on bulk movements

- **Cleanliness:** Industries which is from the medicinal or biochemical will prefer the hygiene of the product where they maintain the integrity of the quality and do not want to lose the reputation of their company/brand
- **HSE Risks:** It's common in industries to avoid any HIPO incidents, which can cause their workers and downtime of the production time
- **Rejections:** Industries don't want to spend much time in resources for thorough inspections other than the required dimensions, while receiving and storage of these pallets

Therefore, integrating the previously discussed concerns into practical field strategies is essential for businesses, enabling them to fully realise the advantages of effective palletising solutions.

Research Gap

This study is grounded in a comprehensive comparative analysis of wooden pallets versus their proposed alternative plastic pallets across multiple dimensions. This comparative framework facilitates the development of practical solutions, validated by measurable outcomes. Each framework reveals unique strengths and challenges in modelling and problem-solving, crucial for advancing material alternatives, which are essential to consider when exploring advanced alternatives. Accordingly, this research offers a thorough literature review on plastic pallets, emphasising key benefits and the most prominent conceptual models. Additionally, the study proposes employing a convenience testing method to assess the technical and commercial viability of plastic pallet usage

Objectives of the Study

The main objectives of this study are as follows: -

- Limiting the usage of natural resources such as lumber in pallet production, which contributes to deforestation and ecosystem disruption
- To identify a sustainable and recyclable alternative capable of supporting ecological and economic stability

Research Methodology

The research is based on a comprehensive comparative analysis between wooden pallets vs the proposed alternative, that is, plastic pallets, in all aspects. However, this type of approach can lead to effective final solutions with practical feasibility in proven results.

Each of the analysis studies present pros and cons both in the modelling and resolution approach which are essential when proposing advanced logistical solutions. Therefore, this work presents a literature review on the proposed alternative pallet with advantages, focusing on the most projecting approaches and characteristic modelled within it.

This study proposes the adoption of convenience testing methods on the usage of plastic pallets to evaluate on technical and commercial benefits.

Analysis & Discussion

According to ASTM D1185-98a (2017) “a globally recognised standard”, standard testing procedures for pallets and related structures used in material handling and shipping involve static load and torsion evaluations. These assessments are essential for determining critical performance metrics such as stiffness, strength, and safe operating load capacities under designated load and support scenarios. The results serve as design guidelines and support performance comparisons between differing pallet constructions and configurations. Mandatory acceptance tests tailored to both general and specialised applications must reflect realistic usage conditions and be conducted using appropriate load parameters and timeframes. One such test, known as "creep analysis" (long-term deformation under stress) measures the long-term behaviour of pallets when subjected to extreme environmental factors, including fluctuating temperatures and pressures. For instance, pallets may be tested under vacuum conditions or at high altitudes with low atmospheric pressure to simulate real-world transportation scenarios.

Another evaluation method, the drop test, involves releasing the pallet from a height of approximately one meter to assess structural integrity. Post-drop inspections focus on corners and edges to determine the extent of damage. This kind of testing replicates routine handling in warehouse operations. Results from these trials on plastic pallets can be formally recorded and certified, ensuring that purchasers receive products with verified durability and suitability for intended use.

Limitations of the Study

Its role in promoting the efficient use of natural resources can have negative implications for the ecological system, emphasising the need for mindful environmental management. Ultimately, these efforts may result in measurable cost savings.

Conclusion

The consequences of deforestation, including its influence on climate change and timber harvesting, highlight the need for balanced alternatives within the industry. In this context, palletising plays a crucial role in modern logistics, enhancing product handling and optimizing spatial efficiency across various facilities.

This research systematically analyzed relevant studies using tabulated methodological assumptions drawn from available reference data and it was tested physically with the results of load test and durability of the proposed alternative which can be recycled in all the ways to fulfill the demand

Scope for Further Research

Based on the forecast of 2032, the increasing demand on wooden pallets could be replaced by sustainable alternatives that are feasible for global implementation all over the world to diversify the areas showing the facts and research testing methods leading to a significant reduction in deforestation. Instead, it will lead to new era with recycling methods with same purpose.

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